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Method for the Operation of a Sliding Closure as well as a Sliding Closure

The invention concerns a method for the operation of a sliding closure for metallurgic vessels, whereby the said sliding closure incorporates at least opposingly tensionable fireproof closure plates which are each, slideably opposingly, positioned along glide surfaces within a housing part, and whereby spring elements are envisaged for the tensioning of the closure plates in at least one of the housing parts, and whereby one closure plate with its housing part can be pushed into a closed, i.e. open position by a drive member.

Sliding closures are utilised especially for the pans or distribution containers of extrusion moulding plants for a controlled pouring of the steel smelt. The fireproof closure plates and fireproof sleeves utilised for these sliding closures, through which the liquid steel smelt flows, as well as the mechanism supporting the same are subjected to relatively strong wear. The plates and sleeves must therefore be replaced frequently.

In order to achieve a high efficiency these fireproof parts are left within the sliding closure and used as long as possible. It has been demonstrated by operating personnel how the emptying of pans can sometimes be achieved with the aid of closure plates and sleeves with visual control and experience. In reality however it has been proven that breakouts occur due to incorrect estimates or insufficient control possibilities, where the steel smelt flows in an uncontrolled manner through the sliding closure and damages or even destroys the same. This applies also to incorrect assemblies of the sliding closure where for example insufficient mortar has been installed between the fireproof parts.

Based on the aforementioned it is the purpose of this invention to provide a method for the operation of a sliding closure of the above mentioned type with which operational safety can be increased and possible imminent operational faults such as breakouts can be recognised early.

This task is solved in accordance with the invention by the off- and/or online diagnosis of the operating condition, especially within the area of the closure plates, with which one or more dimensions relating to size, temperature, pressure and/or force of the sliding closure are measured and evaluated either directly or together with additional relevant process parameters in order to be able to judge the operating condition, and therefore also a possible continued use of the sliding closure.

The method of this invention enables the detection and prevention of operational faults and especially breakouts, during which the entire sliding closure mechanics and possibly also parts of the extrusion moulding plant are often destroyed, as far as possible. Incorrect assemblies of the sliding closure especially can be detected and breakouts prevented in this way.

With a preferred embodiment the distance of each of the housing parts receiving the closure plates from one another in a diagonal direction in relation to the plate glide surfaces is used as a dimension, recorded, and transmitted to an evaluating means, whereby said distance is preferably measured in several places. The measuring of the distance of these two housing parts from one another especially enables the diagnosing of the position of the closure plate with regard to changes in a diagonal direction to the glide surfaces and therefore the detection of sheets that may form between the plates.

The pressure of the drive member as well as the stroke position of the slideable closure plate are preferably used as the dimension that is to be measured, i.e. recorded and evaluated, whereby the friction relationships and therefore the condition of the closure plates especially can be deducted from their contacting glide surfaces.

Embodiments of the invention as well as further advantages of the same will now be described in more detail with reference to the drawings; whereby:

Fig. 1 shows a schematic illustration of a sliding closure as well as an evaluating means working according to the method of this invention, and

Fig. 2 shows a cross-sectional view of a sliding closure with a measuring unit.

Fig. 1 shows a schematic illustration of a sliding closure 10 affixed to a metallurgical vessel 15 illustrated only in part, whereby the same consists for example of a pan of an extrusion moulding plant containing steel smelt. As part of the vessel 15 a steel jacket 11, a fireproof cladding 12, a perforated stone 14, as well as a fireproof sleeve 13 with an outlet 16 are shown.

The sliding closure 10 incorporates an upper housing part 17 into which a fireproof closure plate 21 is affixed. Within a further housing part 19 the slideable closure part 22 is held, whereby the housing part 19 is held within a housing frame 18 and can be moved by a drive member 25 into an open position – as illustrated – or into a closed position. This drive member 25 takes the form of a hydraulic piston/cylinder unit and is therefore activated via pipes 26, 27 by a hydraulic aggregate 29. In addition the closure plates 21, 22 are pressed against one another by spring elements 23, so that an adequate seal is created between the same.

According to the invention the method for the operation of the sliding closure 10 incorporates an off- and/or online diagnosis of the operating condition, especially

within the area of the closure plates 21, 22, during which several dimensions with regard to size, temperature, pressure and/or force of the sliding closure 10 are measured and evaluated either directly or together with additional relevant process parameters in order to be able to judge the operating condition and therefore also a possible continued use of the sliding closure 10.

During the evaluation all dimensions measured as actual values are compared with a target value or a target value range, and a display or suchlike for the checking or the emergency closure of the sliding closure is activated if deviations outside of the tolerance limit are found to exist.

Within the context of the invention the pressure of the drive member as well as the stroke position of the slideable closure plate is recorded and evaluated as one of the dimensions to be measured, whereby especially the friction relationships and therefore the condition of the closure plates can be judged in this way with the aid of their contacting glide surfaces. For this purpose the supply lines 26, 27 of the cylinder are equipped with pressure sensors 28 which measure the actual pressure and supply corresponding signal values via electric cables 28' to an evaluating means 20.

During the measuring of the pressure of the drive member conclusions regarding the friction relationships of the plates 21, 22 depending upon the stroke position of the sliding plate 22 in relation to the floor plate 21, and also regarding the application pressures of the spring elements 23 can be reached. If a deviation from the relevant target value is detected the pouring process can either be discontinued, or the sliding closure can be subjected to a suitable inspection following the conclusion of the pouring process and a necessary replacement of the closure plates or other defective parts carried out depending on the extent of the deviation. As soon the

measured values return to within the tolerance value range following the inspection the sliding closure can be used again.

Further dimensions consist of the temperature measured near the closure plates 21, 22. For this purpose the housing parts 17, 19 are equipped with measuring sensors 31, 32 at various points, whereby the same measure the actual temperatures and transmit the same via relevant electric cables 33, 34 to the evaluating means 20. These temperature measurements enable the detection of possible leaks where liquid steel could exit between plate and sleeve, or between the plates, as early as possible in order to avoid breakouts. As soon as at least one of these temperatures deviates from a predetermined value the closure can either be closed immediately or a message can be sent to request an inspection depending on the extent of the deviation.

Effectively, the evaluating means 20 incorporates a computer with a monitor 61 and a keyboard 62 for the programming and the menu-driven administration of the method. In addition an emergency light 63 and an alarm 64 are envisaged, with which possible operational faults of the sliding closure can be audibly, i.e. visually notified. The evaluating means 20 could of course also be connected to an external computer, i.e. a central computer, located for example at a control centre.

In addition, the application pressure of the spring elements 23 that tension the closure plates 21, 22 can be measured in order to determine whether one or more of the spring elements 23 are no longer functional. Such a measurement can be carried out with the aid of an expansion measurement strip or a piezo element or suchlike.

These pressure measurements as well as the temperature measurements can be carried out online, i.e. during the pouring process and/or offline, i.e. after the pouring

process, when the sliding closure has been positioned at an assembly location together with the pan.

The target value or the target value range of the dimensions that are to be measured with the aid of the additional process parameters can be adjusted during the use of the sliding closure. In this way it is for example possible that the wear of the glide surfaces , i.e. the flow passages of the closure plates will have an effect on the temperatures detected by the measuring sensors 31, 32. In the same way it is possible that a temperature increase occurs during the use of the closure without any kind of defect being present. These changes are defined as the kind of process parameters which are borne in mind during the evaluation of the measured dimensions.

A further characteristic of the method of this invention envisages that a protocolling and a storing of the measured dimensions of the sliding closure will supply information regarding the pan and the smelt to be poured with regard to temperature, treatment, pouring time etc. These stored dimensions also serve as process parameters to be considered during the evaluation, with which the target values are adjusted and a filtering process as part of the comparison of measured dimensions is carried out with the target values in order to exclude false alarms as far as possible.

Fig. 2 shows a sliding closure 40 which is described in detail in document WO-A-00/6325, of which only the details relevant to this invention are mentioned below. An upper housing part 47 affixed to a vessel 35 is envisaged here together with a closure plate 41 that can be affixed within the same as well as a lower housing part 49, in which a fireproof closure plate 42 is held, which is moveably arranged vertical in relation to the drawing plane. Roller guides 44 are located on the upper housing

part 47, through which the housing part 49 is guided within the same in a moveable way. The spring elements effect the movement of the lower towards the upper closure plate 41, 42 via these roller guides 44.

Within the context of the invention the housing parts 47, 49 are preferably equipped with two measuring sensors 50 on both sides, each arranged at a distance from the other, with which the distance 53 of the two housing parts from one another in a diagonal direction with relation to the plate glide surfaces 41', 42' is recorded and transmitted to the evaluating means 20 via a relevant cable 51. These measuring sensors 50 affixed to the upper housing part 47 each measure a distance 53 to a measuring element 52 affixed to the lower housing 49.

These measuring sensors 50 and measuring elements 52 are preferably encapsulated in a way not described in detail here, so that the same are protected against damage. They can also be integrated directly into the housing parts 47, 49. In principle a single measuring sensor 50 would also suffice.

With the measuring of these distances 53, i.e. the linear changes of the two housing parts 47, 49 in relation to one another, it is possible especially to diagnose the position of the closure plates 41, 42 with regard to diagonal changes in relation to the glide surfaces 41', 42'. If, for example steel smelt enters between the plates a thin sheet can form there which can press the plates apart and therefore create a risk of an uncontrolled outpouring of steel smelt across the glide surfaces between these plates.

The invention has been described sufficiently with reference to the above embodiments. However, various other embodiments are possible.

In principle the sliding closure could be evaluated with the aid of only one of the dimensions described above, i.e. size, temperature, pressure and/or force,

preferably in a programme-controlled way.